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ABSTRACT

The study attempted to determine the feasibility of performing a cost-effectiveness analysis comparing the cooperative method to methods which do not use work experience in vocational training. Twelve school districts in Minnesota, North Carolina, and Ohio provided data for the study, involving the design of data collection instruments for cost and effectiveness information, descriptive information about programs and students, and an attitudinal survey instrument for employers of graduates. The conclusions are: it is possible to collect and analyze cost and effectiveness information on vocational education programs; there are no clear-cut cost advantages or disadvantages between the two methods; a large-scale study is needed to assist in policy formulation for vocational education. The survey employers indicated they favor graduates of cooperative programs. (A six-item bibliography is appended.) (Author/BP)

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COST EFFECTIVENESS ANALYSIS OF SELECTED VOCATIONAL PROGRAMS WITH COOPERATIVE COMPONENTS VERSUS IN-SCHOOL VOCATIONAL PROGRAMS

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For Presentation at
1975 Annual Meeting of the
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March 30-April 3, Washington, D.C.

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ABSTRACT

A detailed cost analysis was performed as a part of a study to compare the cost effectiveness of vocational programs having cooperative components (co-op) and vocational programs conducted entirely in the school (non-co-op). The data were collected from twelve school districts. The cost analysis showed that there is not a clear-cut difference in costs between co-op and non-co-op programs when aggregate cost measures are used. A strong logarithmic relationship was found between student-teacher ratio and cost per student, regardless of the type of vocational education method that is practiced. It is suggested that all educational cost analyses consider this relationship prior to attempting to explain cost differences based on other variables.

The effectiveness comparisons were based mostly on standard follow-up information provided by the schools on graduates of the vocational programs. In addition, a brief survey of employers was conducted to obtain some attitudes from employers regarding graduates of co-op versus non-co-op programs. The overall conclusion based on the follow-up measures is that there is no obvious difference between graduates of co-op vocational programs and graduates of non-co-op programs. The overall conclusions based on the employer survey are that employers tend to favor graduates of co-op programs and that measuring effectiveness through a questioning of employers results in a much more clear-cut differential between co-op and non-co-op programs than does an analysis of follow-up information normally collected by school systems.

COST EFFECTIVENESS ANALYSIS OF SELECTED VOCATIONAL PROGRAMS WITH COOPERATIVE COMPONENTS VERSUS IN-SCHOOL VOCATIONAL PROGRAMS*

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INTRODUCTION

Public vocational education programs, as directed toward the goal of producing skilled workers, have employed a variety of methodologies for this purpose. One of the most basic distinctions that can be made in these methodologies concerns "in-school" versus "out-of-school" learning experiences. Thus, some vocational education programs have developed "cooperative" work experiences with business and industry to help in providing job skills. The essence of this idea is to provide actual on-the-job working experiences as a part of the educational program. Seemingly, vocational education programs with a cooperative

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* This paper was derived from:

Molnar, D.E., Pesut, R.N., and Mihalka, J.A., Cost Effectiveness of Selected Cooperative Vocational Education Programs as Compared With Vocational Programs Without a Cooperative Component, Final Report, Battelle-Columbus Laboratories, Columbus, Ohio, June 29, 1973. This final report contains a review of the literature on cooperative vocational education and relevant cost effectiveness analyses.

component should meet the goal of producing skilled workers to a greater degree than vocational education programs that do not have a cooperative component, for two principal reasons. First, for many occupations, it is difficult to conceive that students can receive training solely through classroom and shop courses that is equivalent to the training received by students who have on-the-job experiences as part of their program. Second, the real-life experience has been one criterion used by employers in hiring new employees.

Nevertheless, there are difficulties with both of the positive aspects of cooperative vocational education mentioned above. Unless the school system provides teacher-coordinators who are truly involved in the work experiences, the job tasks given to the students might not be sufficiently relevant to the educational objectives (e.g., there may be no planned progression in assigned job tasks).

Due to the pressures of conducting business, employers might not have the time, patience, or instructional experience to help the cooperative students in a meaningful way. Thus, there is a question as to whether vocational programs with a cooperative component are any better than those without a cooperative component, i.e., whether all the available instructional time might be better spent in "in-school" learning experiences.

The research question to be answered is whether or not there is a difference in the effectiveness and the cost of vocational programs with a cooperative component versus those without a cooperative component.

Thus, the basic analysis procedure needed to answer the research question is a cost-effectiveness comparison of the two types of vocational education.

This research study was directed toward a preliminary determination of the cost-effectiveness of selected cooperative-vocational education programs and the cost-effectiveness of selected vocational programs that do not have a cooperative component.

PURPOSE AND SCOPE OF THE STUDY

The stated purposes of this exploratory study were:

1) To identify and describe the various types of cooperative and non-cooperative vocational programs currently being conducted

2) To obtain cost comparisons between vocational programs utilizing the cooperative method and regular vocational programs

3) To assess the effectiveness of various types of vocational programs

4) To obtain data on the type of students in various vocational programs, together with student performance in these programs.

An ancillary purpose was to determine the present status of data available for making successive in-depth analyses.

This paper concentrates on the results of the study relative to the second and third objectives. These deal with the cost and effectiveness comparisons and the methodology used. The emphasis is appropriate for the AERA session, "Studies in Educational Planning and Management".

The study focused on vocational programs at the secondary level. The following definitions were used throughout the study.

- Vocational education is defined to include only high school programs--usually the junior and/or senior years. A vocational program is intensive occupational preparation for a specific occupational objective, or a cluster of occupations and should not be confused with industrial arts programs which are more exploratory in nature.
- Co-op vocational education is defined to include the following characteristics:
  - The co-op student is involved in a productive employment situation directly related to his vocational objective.
  - There is a training plan for each co-op student.
  - There is at least one period of in-school instruction directly related to the student's vocational objective.
  - There is available a school-employed coordinator with adequate time for on-the-job supervision of the co-op student.

- Non-co-op vocational education programs are those that provide vocational training totally within the school environment.

SAMPLE POPULATION

Twelve school districts, four in each of three states, Minnesota, North Carolina, and Ohio, served as data sources for the study. The characteristics of these districts are shown in Table 1. Altogether, data were collected from 20 high schools. Because of the effort required to collect and report data, and because of the fact that not all vocational programs exist at each school, particular schools did not report on all of either the co-op or non-co-op programs covered by this study.

Data were collected and analyzed for 14 program areas which were:

Co-op Programs

- Distributive Education
- Diversified Cooperative Training
- Cooperative Office Education
- Trade and Industry
- Cooperative Work Experience *

Non-Co-op Programs

- Auto Mechanics
- Auto Body
- Electronics/Electricity

* The districts that reported on CWE indicated that their programs met our definition of co-op programs.

TABLE 1. PARTICIPATING SCHOOL DISTRICTS AND THEIR GENERAL CHARACTERISTICS

Name of School District	City Location of Central Office	General Characteristic of Community	Approximate Total District Enrollment	Number of Schools		
				High	Junior or Middle	Elementary
• Minnesota						
South Washington Co. Schools Independent School Dist. No. 833	Cottage Grove	Urban Fringe[a]	12,000	1	3	9
Duluth Public Schools Independent School Dist. No. 709	Duluth	Large City	22,900	4	5	32
Worthington Public Schools Independent School Dist. No. 518	Worthington	Small City	3,300	1	1	5
Shakopee Public Schools Independent School Dist. No. 720	Shakopee	Urban Fringe[a]	2,000	1	1	3
• North Carolina						
Caldwell Co. School Dist.	Lenoir	Small Town/ Rural	12,500	4[b]	-	14[c]
Charlotte-Mecklenburg School Dist.	Charlotte	Large City	79,000	10	21	73
Eden City Public Schools	Eden	Small Town/ Rural	4,900	1	1	9
Winston-Salem/Forsythe Co. Schools	Winston-Salem	Large City	48,000	5[d]	19[e]	-
• Ohio						
Lancaster City School Dist.	Lancaster	Small City	8,800	1	3	10
Mentor Exempted Village School Dist.	Mentor	Small Town/ Rural	13,000	1	3	12
South-Western School Dist.	Grove City	Urban Fringe[f]	17,200	4[g]	5	18
Lorain City School Dist.	Lorain	Large City	17,600	3	2	16

(a) Minneapolis - St. Paul

(b) Grades 9-12

(c) Grades 1-8

(d) Grades 11-12

(e) 11, Grades 7-8; 8, Grades 9-10

(f) Columbus

(g) Includes 1 technical school

- Drafting
- Machine Trades
- Special Office Training (one school district reported on this program)
- General Office
- Stenographic
- Welding.

COST ANALYSIS

In order to estimate the yearly cost of a program, data were collected for three main cost components-- building construction cost, direct instructional cost and laboratory equipment replacement cost. The building construction cost was amortized over a 25-year period, with cost adjusted to 1971 dollars based on the year of construction. No discounting to present value was included. This cost was prorated to a given vocational program based on the square footage and the proportion of time the space was used by the program. The direct instructional cost included total teacher salaries, and fringe benefits, instructor's mileage expense for transportation, consumable supplies and material costs, laboratory equipment rental cost, and laboratory equipment contract repair costs. The direct instructional cost was calculated as an average of the actual expenditures for the 1969-70 and 1970-71 school years.

The estimate of laboratory equipment replacement cost was based on three estimates given for each program--a lowest estimate, an average estimate, and a highest estimate of what it would cost in terms of 1971 dollars to replace all equipment used by the program. These three estimates were converted to a weighted average as an overall estimate using the following equation:

$$C = (Cl + 4Ca + Ch) /6,$$

where Cl is the lowest estimate, Ca is the average estimate, and Ch is the highest estimate. The method of averaging follows the procedures used in PERT-type analyses for such estimation problems.[1*] The resulting average cost was amortized over 25 years for programs using heavy equipment and 10 years for programs using office equipment to yield an average annual cost.

The sum of the annual estimates for the three cost components--building construction cost, direct instructional cost, and laboratory equipment replacement cost--was assumed to represent the total annual cost of a particular vocational program at a particular school.

From this total annual cost measure, two other measures were derived. The first of these is an average annual cost per student. The total numbers of 1970-71 senior and 1969-70 junior students were used for this purpose. The sum of these two totals represent an estimate of the yearly total number of students being trained within a particular program. The average annual cost per student was calculated as the ratio of total yearly cost to the total number of students for a particular program at a particular school.

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* References are listed in the REFERENCE section of this paper.

The second measure is the average annual cost for each hour spent in vocational training per week. This measure was calculated as the ratio of the annual total cost to the total number of student-hours per week spent in instruction within a program. (This is analogous to the cost per credit hour that is used in college and university settings, and in some high schools.) For students in co-op programs the average number of hours per week in coordination by the teacher-coordinator was also included because the school system must bear this cost. The reasons for using this measure are discussed below.

Table 2 is a summary of the cost analysis by program, across all schools. In this table and in the remainder of the discussion, the term "Cost Per Student" is the average annual cost per student and the term "Cost Per Student-Hour" is the annual cost for each hour spent in vocational training per week.

Several points become evident when Table 2 is considered. Considering first the Cost Per Student, the table shows an average of $355 for co-op programs and $545 for non-co-op programs. This is a differential of $190. However, if individual programs are considered, the variability of costs for each of the two methods, co-op and non-co-op, is quite large. Several co-op programs show costs higher than non-co-op programs, and vice versa. This variability is even more pronounced on an individual school basis. It becomes questionable then whether or not the $190 differential is statistically significant.

TABLE 2. SUMMARY OF AVERACE ANNUAL COSTS BY TYPE OF PROGRAM

PROGRAM	Direct Instructional Cost/Student	Building Construction Cost/Student	Laboratory Equipment Cost/Student	Number Student-Hours	Cost Per Student-Hour	Number Students	Cost Per Student
ALL PROGRAMS	$ 360	$ 50	$ 44	42398	$ 35.12	3286	$453.19
Co-op	312	24	19	13988	40.35	1590	355.03
Distributive Education	221	18	8	6315	32.74	839	246.45
Diversified Cooperative Training	320	20	1	2907	40.99	349	341.41
Cooperative Office Education	483	49	61	3351	48.87	276	593.33
Trade & Industry	745	22	195	485	71.42	36	962.20
Cooperative Work Experience	431	15	1	930	43.20	90	446.40
Non-co-op	495	74	66	28410	32.55	1696	545.21
Auto Mechanics	466	91	37	5227	28.85	254	593.66
Auto Body	381	89	18	270	48.84	27	488.38
Electronic/Electricity	466	66	43	4540	32.31	255	575.23
Drafting	454	27	9	3055	31.86	198	489.14
Machine Trades	417	148	143	4627	41.91	274	707.83
Special Office Training	798	87	110	1451	46.62	68	995.04
General Office	322	46	72	4967	29.55	333	440.77
Stenographic	252	54	51	3391	25.48	242	357.09
Welding	289	49	159	880	24.87	44	497.34

Furthermore, detailed analysis of costs by program and schools indicates that the principal contribution to the Cost Per Student is in the direct instructional cost element, which in turn might indicate that the total number of student-hours in the program might be an important normalizing factor. One reason for this is that the average hours per week spent in vocational laboratories and other vocational studies differs markedly for the two types of programs, viz.,

- 8.8 hours per week for co-op programs
- 16.8 hours per week for non-co-op programs.

Thus, we see that there are almost twice as many hours per week spent in school in the non-co-op vocational training as in the in-school co-op vocational training. This in turn might cause lower student-teacher ratios in non-co-op programs, and thus higher direct instructional cost per student. For this reason the Cost Per Student-Hour was studied, since this measure accounts for differentials in instructional contact hours.

The measure of Cost Per Student-Hour in Table 2 indicates the following averages:

- $40.35 for co-op programs
- $32.55 for non-co-op programs.

This is a reversal of the relationship shown by the first measure, and indicates a differential of about $8 per student-hour. Once again, detailed analysis of costs by program and school shows wide variability in this measure and it becomes questionable whether or not this $8

differential is statistically significant. Because of the wide variability in the measures when considering programs at particular schools, the significance of the cost differences was questioned. A statistical test of significance for each of these two measures was conducted using Welch's two-sample test with unequal variances.[2] This test was modified to account for the fact that weighted means were being tested ("number of students" for the measure--Cost Per Student; and "number of student-hours" for the measure--Cost Per Student Hour). The modification was accomplished by using the Statistical Package for Social Scientists.[3] (Welch's test procedure yields an approximate test, not an exact one.)

The test of significance for the mean Cost Per Student ($335 for co-op programs versus $545 for non-co-op programs) yielded a test statistic of -3.19 with approximately 79 degrees of freedom. The test of significance for the mean Cost Per Student-Hour ($40.35 for co-op programs versus $32.55 for non-co-op programs) yielded a test statistic of 1.70 with approximately 66 degrees of freedom. These results are statistically significant at the 0.1 level of significance. Although it appears that the differences are significant, the two measures yield different conclusions about the programs. Also it should be remembered that since the sample of schools and programs studied may not represent a random selection, the application of statistical tests of significance which are based upon the assumption of random sampling is questionable. We feel it would be unwise to accept the results of the above tests as

conclusive. However, since this study was an exploratory study directed toward determining the feasibility of conducting larger scale studies of the same nature, the tests have been included as illustrative models for future studies.

In an attempt to further understand the variability within the two cost measures being studied, further analysis was performed using the student-teacher ratio as an independent variable. Scattergrams of the two cost measures versus the student-teacher ratio showed a definite logarithmic relationship. Regression analyses were performed on the data with very significant results. Table 3 shows the results for the measure, Cost Per Student; Table 4 shows the results for the measure, Cost Per Student-Hour.

Figure 1 shows the regression of the natural logarithm of student-teacher ratio versus the natural logarithm of Cost Per Student; Figure 2 is the regression for the measure Cost Per Student-Hour. Notice that in both cases the lines for all programs, co-op programs and non-co-op programs are very similar in slope and intercept.*

These regression analyses show, as one would intuitively expect, a very strong logarithmic relationship between the cost measures and the student-teacher ratio.

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* To convert the natural logarithmic scale simply use the coordinates from the figures and raise the irrational number denoted by "e" (approximately 2.71828) to the power corresponding to the value. For example, from Figure 1, the point (3.0; 6.5) for the line for all programs corresponds to the point (20.1; 665) on the arithmetic scale. This means that a student-teacher ratio of 20.1 corresponds to an average annual Cost Per Student of $665.

TABLE 3. REGRESSION ANALYSIS ON COST PER STUDENT

Data Base	Regression Equation*	Correlation (R)	R^2	Significance Level
All Programs	Y=9.43-0.98X	-0.92	0.85	0.00001
Co-op Programs	Y=9.85-1.10X	-0.96	0.92	0.00001
Non-Co-op Programs	Y=9.07-0.87X	-0.88	0.77	0.00001

* Y = Natural logarithm of Cost Per Student
  X = Natural logarithm of Student-Teacher Ratio

TABLE 4. REGRESSION ANALYSIS ON COST PER STUDENT-HOUR

Data Base	Regression Equation*	Correlation (R)	R^2	Significance Level
All Programs	Y=5.05-0.42X	-0.45	0.20	0.00001
Co-op Programs	Y=5.45-0.47X	-0.45	0.20	0.00223
Non-Co-op Programs	Y=5.41-0.59X	-0.67	0.48	0.00001

* Y = Natural logarithm of Cost Per Student-Hour
  X = Natural logarithm of Student-Teacher Ratio

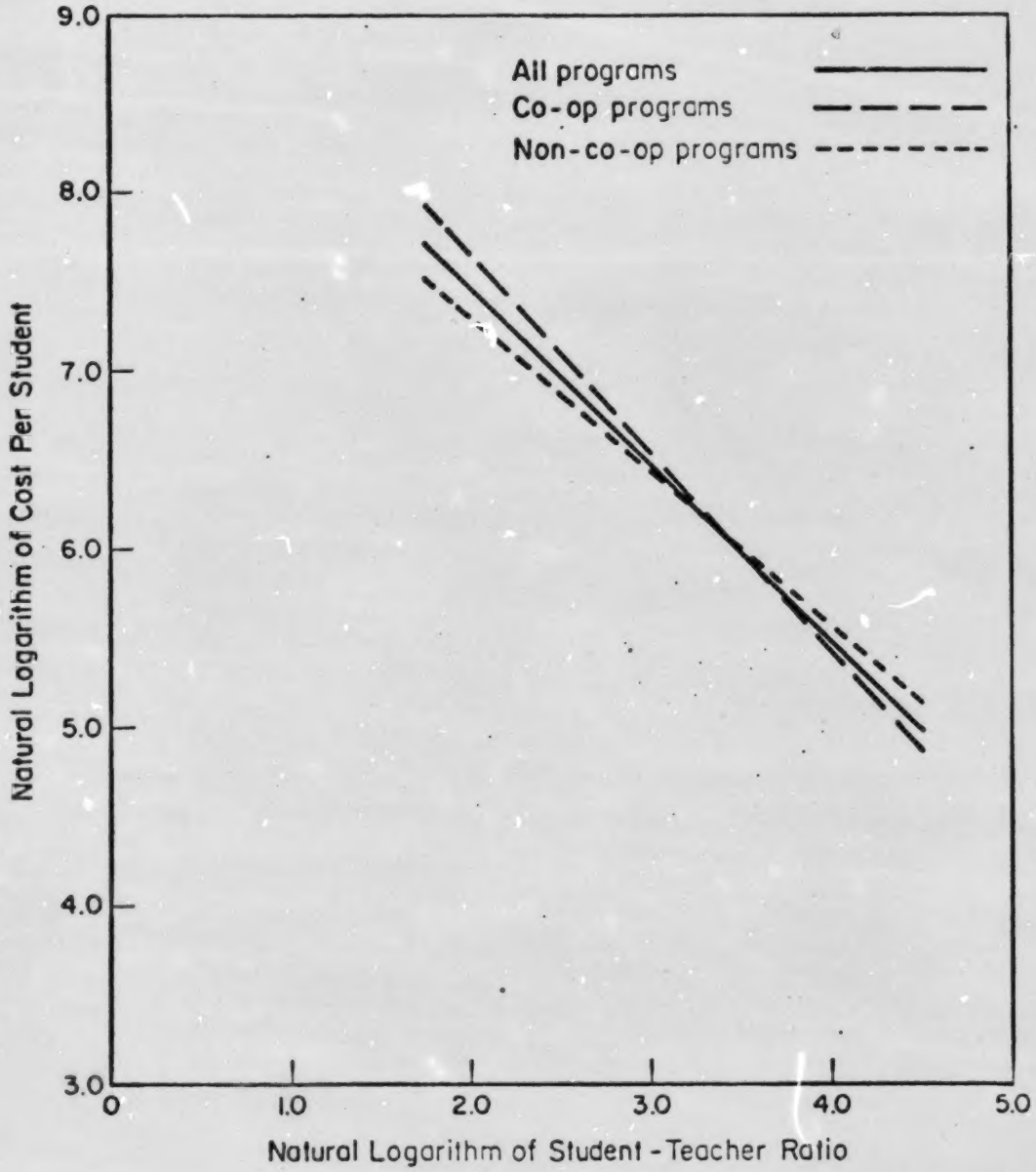


FIGURE 1. PLOT OF REGRESSION LINES FOR COST PER STUDENT

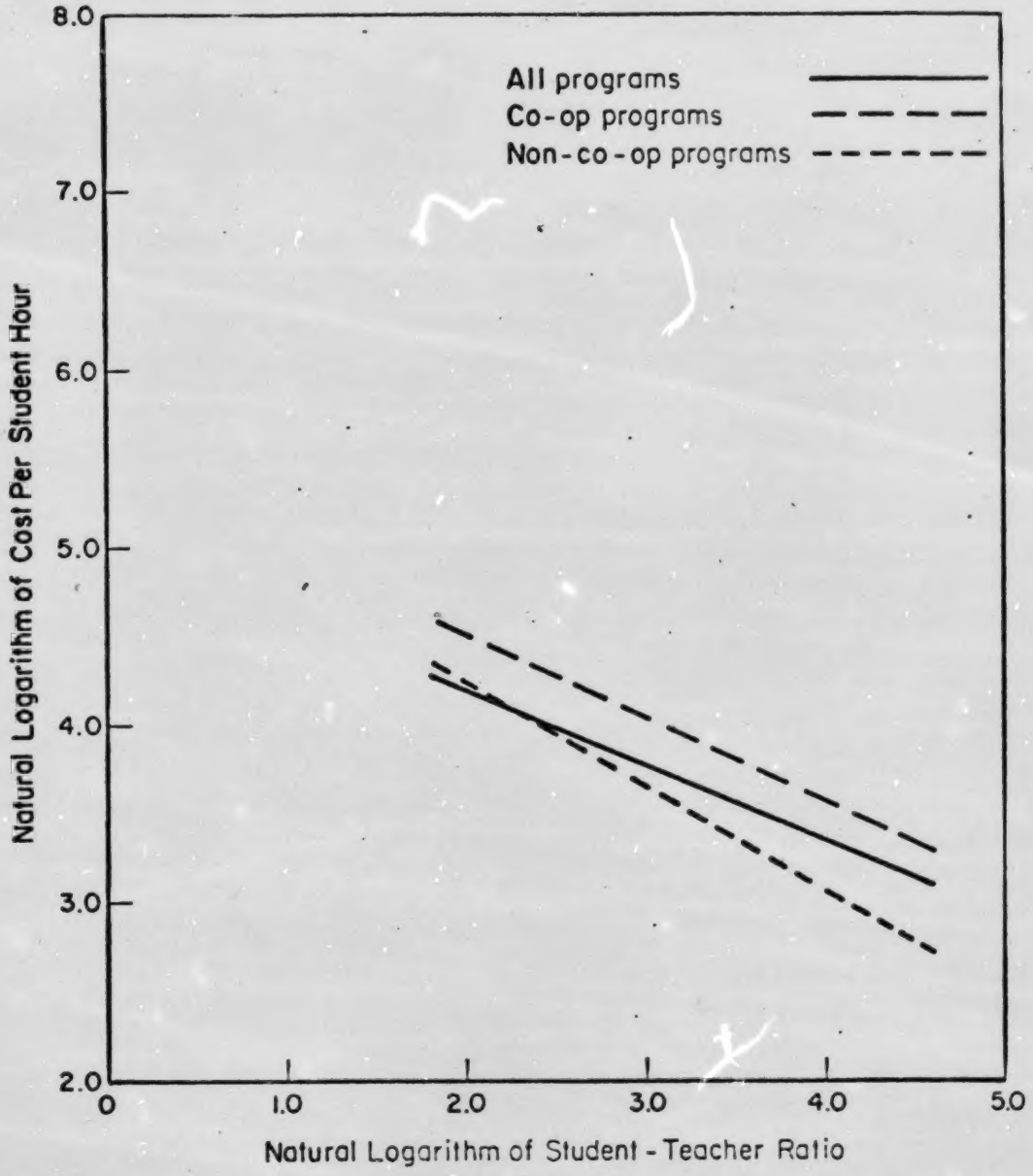


FIGURE 2. PLOT OF REGRESSION LINES FOR COST PER STUDENT HOUR

In summary, the cost analysis does not show a definite differential between the two methods typically used in vocational programs--co-op and non-co-op.

Based on the cost data collected, we used two cost measures for analysis purposes--Annual Cost Per Student and Annual Cost Per Student-Hour. The Annual Cost Per Student measure shows a differential of about $190, favoring co-op programs. This differential is a marginal statistically significant difference. On the basis of cost per student hour, there is a differential of about $8, favoring non-co-op programs. This difference is also marginally significant. There is wide variation in both measures across programs and across schools, but these variations can be explained very well as being a function of the student-teacher ratio. That is, the cost of a program is not a function of the program, nor the method, but the efficiency with which human resources (teachers) are used.

Thus, our overall conclusion, based on this initial study, is that there is no obvious difference in the cost of providing either cooperative vocational education programs or those without a cooperative component.

EFFECTIVENESS ANALYSIS BASED ON SCHOOL-PROVIDED DATA

Ten effectiveness measures were developed from information collected from the schools. The purpose of the measures is to serve as indicators of differences among programs, and particularly between co-op and non-co-op programs on an aggregate basis. These measures are the following:

(1) Percentage of students graduating

(2) Percentage distribution of employment status

(3) Mean entry wage rate per hour

(4) Mean most recent wage rate per hour

(5) Percentage distribution of location of initial employment

(6) Percentage distribution of location of most recent employment

(7) Percentage of graduates admitted to formal apprenticeship programs

(8) Percentage of graduates with two or less employers

(9) Mean length of longest employment (months)

(10) Mean number of weeks after graduation until obtaining full-time employment.

In calculating the effectiveness-measure estimates, it should be remembered that the data base consists of a sample of students from an individual program, and not necessarily the entire population of

students within the program. Where the number of students in a program was small, however, the respondent tended to supply available data for all students. The net effect of this collection process was that the data available for the effectiveness analysis constituted a representative sampling of data on students within the programs and did not constitute a survey of the complete student population in the programs. A total of 1376 students formed the sample for which all or part of the data were reported.

The first measure, Percentage of Students Graduating, is intended to provide a measure of the success of the individual program types being studied. It was calculated as the ratio of the number of students graduated to the total number of students either graduated or not graduated. No inferences were made concerning missing data, and missing data were excluded from the calculation. No data were available for 9 percent of the students on this measure.

The second measure, Percentage Distribution of Employment Status, can be used to measure the effectiveness or ineffectiveness of the various program types. The data were classified into one of five categories:

(1) Presently employed

(2) Continued education after graduation

(3) Entered military services

(4) Unavailable for employment

(5) Presently employed.

The graduates who continued their education after high school include those enrolled in a four year college, a full-time two year community

or junior college, a technical school or other post-secondary school. The graduates unavailable for employment include those with family responsibilities or other reasons for not being available.

With the classification of the data into the five employment status categories, percentages were calculated for each category as the ratio of the number of graduates in the category to the total number for all five categories. Missing data were excluded and represent about 17 percent of the data.

The third measure of effectiveness, Mean Entry Wage Rate Per Hour was calculated as an arithmetic average for each program, as was the fourth measure, Mean Most Recent Wage Rate Per Hour. The two measures together represent an index of the progress of graduates from particular programs for comparison purposes. Data for a particular program was reported according to one of three follow-up periods--3 to 6 months, 7 to 12 months, or 13 to 18 months. Since most of the responses were based upon a 13 to 18 month follow-up period, attention was focused on this set of data, and the few cases for the other follow-up periods were excluded. This is so only for the Most Recent Wage Rate Per Hour and not for the Entry Wage Rate Per Hour. Missing data for the Entry Wage Rate Per Hour amounted to about 61 percent of the students, and for Most Recent Wage Rate Per Hour about 76 percent. An additional 4 percent of data based upon shorter follow-up periods was excluded also. It should be remembered, however, that a substantial part of these missing data is due to students not being available for employment. Nevertheless, this appears to be a difficult data item to collect.

The fifth and sixth measures of effectiveness deal with the location of initial and most recent employment, respectively. These measures are intended to indicate in part the degree to which the vocational programs serve the employment needs of the communities. Percentages were calculated as the ratio of the number of graduates in one of three categories to the total number of graduates for which data were available. The three categories are:

(1) Employed within the local labor market

(2) Employed outside the local labor market but within the state

(3) Employed outside the state.

For initial employment location, data were available on about 42 percent of the graduates and for most recent employment location, data were available for about 39 percent of the graduates. Of course, some of the "missing" data in fact are not missing but represent graduates who did not enter the labor market for some reason or were unemployed.

The seventh measure, Percentage of Graduates Admitted to a Formal Apprenticeship Program, was calculated as the ratio of the number of positive responses to the total number of positive and negative responses. Excluding missing data from the calculation resulted in data being available for about 34 percent of the graduates.

The eighth measure of effectiveness was the Percentage of Graduates with Two or Less Employers Since Graduation. It was calculated as the ratio of the number of graduates for which two or less employers were reported, to the total number of graduates for which data were

available, excluding missing data. Data were available for approximately 60 percent of the graduates. Missing data again includes graduates not available for employment.

The ninth measure of effectiveness, Mean Length of Longest Employment was calculated as an arithmetic average, excluding missing data. Once again, since the majority of the data were reported for a 13 to 18 month follow-up period, only data for this period were included, to the exclusion of data for the other follow-up periods, and missing data. The estimates to be presented represent about 29 percent of the graduates. Missing data here also includes graduates not available for employment.

The tenth and final measure, Mean Weeks After Graduation Until Full Time Employment, was calculated as an arithmetic average, excluding missing data. Data were available for approximately 40 percent of the graduates. The missing data and graduates not available for employment represent the 60 percent of unavailable data.

In all cases where arithmetic averages were calculated, standard deviations were also calculated to provide an indication of the spread or variation in the data. Standard statistical formulas were employed for these calculations. For random samples of approximately 40 or more observations, the arithmetic average plus or minus two times the standard deviation, represent approximately 95 percent confidence limits for a particular observation.

Results of the Effectiveness Analysis Based on School-Provided Data

Table 5 presents a summary of the results of the effectiveness analysis for each of the ten effectiveness measures for the study. These results are presented for twelve of the fourteen vocational program areas included in the study, for each of the two aggregate program types (co-op and non-co-op) and for all programs. Data were not reported by the school districts for two of the non-co-op program areas, Special Office Training, and Welding, and these two program areas consequently do not appear in the Table. Blank entries in the table indicate additional cases where data were not reported for a particular effectiveness measure. Wherever it was felt that the number of graduates upon which a measure was estimated would be informative, that information was included in the Table. The interpretation of these results is presented in the following section.

Interpretation of Effectiveness Analysis Based on School-Provided Data

In Table 5, the first effectiveness measure, Percentage of Students Graduating, ranges from a low of 75 percent for the non-co-op Auto Body Program to a high of 100 percent for several program areas. The low was based upon data for only 8 students which is too small a sample to indicate significance. The average percentage for co-op programs does not appear to be significantly different from that for non-co-op programs, and it can be concluded that the methods do not differ significantly if their effectiveness is measured in this manner.

TABLE 5. SUMMARY OF RESULTS OF EFFECTIVENESS DATA COLLECTED FROM SCHOOL RECORDS

Effectiveness Measures		Co-op						Non-co-op								
		Co-op Dist. Educ.	Div. Co-op Trg.	Co-op Office Educ.	Trade and Ind.	Co-op Work Exp.	All Co-op Programs	Auto Mech.	Auto Body	Elect.	Drafting	Mach. Trades	Gen. Office	Steno.	All Non-co-op Programs	All Programs
1. Percentage of students graduating		97.6	97.5	100.0	97.2	100.0	98.2	97.3	75.0	98.0	93.7	94.7	100.0	100.0	97.0	97.9
2. Employment status (percentage distribution)	- Employed	46.9	43.3	58.9	37.1	0.0	46.7	44.4	85.7	28.9	37.0	45.7	44.1	37.2	40.6	44.1
	- Continued education	27.5	23.6	22.1	37.1	64.0	27.1	39.7	0.0	48.4	38.9	28.6	33.3	46.5	37.5	31.6
	- Entered military service	11.5	23.6	1.2	14.3	28.0	12.6	12.7	14.3	15.5	20.4	21.9	1.0	2.3	12.5	12.6
	- Unavailable for employment	10.3	4.4	9.2	8.6	8.0	8.5	1.6	0.0	0.0	0.0	1.0	19.8	14.0	6.3	7.5
	- Unemployed	3.8	5.1	8.6	2.9	0.0	5.1	1.6	0.0	7.2	3.7	2.8	1.8	0.0	3.1	4.2
	- (Number of graduates)	(262)	(157)	(163)	(35)	(25)	(642)	(63)	(7)	(97)	(54)	(105)	(111)	(43)	(480)	(1122)
3. Entry wage rate per hour (dollars per hour)	- Average	1.95	2.17	1.69	2.04	--	1.92	2.23	2.07	2.54	2.24	2.60	1.81	2.00	2.28	2.03
	- (Standard deviation)	(0.56)	(0.58)	(0.16)	(0.61)	--	(0.51)	(0.22)	(0.21)	(0.63)	(0.44)	(0.54)	(0.27)	(0.00)	(0.56)	(0.55)
	- (Number of graduates)	(144)	(85)	(120)	(23)	--	(372)	(14)	(6)	(30)	(17)	(50)	(42)	(3)	(162)	(534)
4. Most recent wage rate per hour (13-18 month follow-up data only) (dollars per hour)	- Average	2.66	2.60	2.20	3.33	--	2.54	2.95	3.02	2.68	2.89	3.19	2.08	2.44	2.73	2.61
	- (Standard deviation)	(0.91)	(0.54)	(0.32)	(1.00)	--	(0.76)	(0.48)	(0.78)	(0.43)	(0.68)	(0.63)	(0.30)	(0.00)	(0.66)	(0.73)
	- (Number of graduates)	(62)	(28)	(64)	(15)	--	(169)	(11)	(6)	(21)	(10)	(33)	(30)	(3)	(114)	(283)
5. Locations of initial employment (percentage distribution) (Co-op = 360 graduates; non-co-op = 215 graduates)	- Within local market	91.8	98.7	97.3	88.5	--	94.7	100.0	100.0	95.2	100.0	95.7	92.7	93.8	95.8	95.1
	- Within state	6.1	1.3	0.0	7.7	--	3.3	0.0	0.0	4.8	0.0	4.3	7.3	0.0	3.7	3.5
	- Outside of state	2.1	0.0	2.7	3.8	--	2.0	0.0	0.0	0.0	0.0	0.0	0.0	6.2	0.5	1.4
6. Location of most recent employment (percentage distribution) (Co-op = 341 graduates; non-co-op = 194 graduates)	- Within local market	86.3	95.7	91.2	87.0	--	89.7	100.0	100.0	86.7	90.5	94.2	86.0	93.8	91.8	90.4
	- Within state	12.3	4.3	3.9	13.0	--	8.2	0.0	0.0	13.3	9.5	1.9	14.0	0.0	6.7	7.7
	- Outside of state	1.4	0.0	4.9	0.0	--	2.1	0.0	0.0	0.0	0.0	3.9	0.0	6.2	1.5	1.9
7. Percentage of graduates admitted to formal apprenticeship program		16.5	4.8	0.0	5.9	--	8.9	12.0	--	12.0	17.6	11.3	3.6	0.0	8.9	8.9
8. Percentage of graduates with two or less employers (13-18 month follow-up data only)	- Percentage	77.1	82.2	86.5	89.5	--	82.4	45.5	100.0	90.9	100.0	65.7	82.1	100.0	79.5	81.4
	- (Number of graduates)	(96)	(45)	(96)	(19)	--	(256)	(11)	(2)	(22)	(10)	(35)	(39)	(13)	(132)	(388)
9. Length of longest employment (months) (13-18 month follow-up data only)	- Average	12.6	13.5	13.6	9.7	--	12.9	13.7	12.7	15.0	14.8	11.7	14.6	16.3	14.0	13.3
	- (Standard deviation)	(4.7)	(4.0)	(4.6)	(4.5)	--	(4.6)	(4.7)	(3.7)	(3.5)	(2.7)	(4.6)	(3.7)	(2.9)	(4.0)	(4.4)
	- (Number of graduates)	(100)	(47)	(94)	(20)	--	(261)	(11)	(6)	(26)	(10)	(35)	(39)	(14)	(141)	(402)
10. Weeks after graduation until full-time employment	- Average	2.5	0.6	2.1	0.4	--	1.7	0.9	5.0	4.2	4.5	2.6	3.5	1.0	3.2	2.3
	- (Standard deviation)	(7.9)	(3.3)	(7.4)	(2.1)	--	(6.6)	(1.4)	(2.9)	(14.7)	(8.4)	(3.2)	(9.3)	(0.0)	(9.0)	(7.6)
	- (Number of graduates)	(133)	(93)	(96)	(23)	--	(345)	(20)	(6)	(47)	(22)	(44)	(56)	(16)	(211)	(556)

When considering the second effectiveness measure, Percentage Distribution of Employment Status, several of the classifications are of particular interest. The first of these is the percentage of graduates currently employed. In Table 5, for co-op programs, 46.7 percent of the graduates are currently employed, and for non-co-op programs, 40.6 percent are currently employed. If a statistical test of significance (difference in two proportions)[4] is conducted, a test statistic of 2.04 results, which is significant for a test at the .05 significance level. Consequently for the program areas studied, the difference in percentage of graduates employed is significant in favor of graduates of co-op programs. However, further examination of this measure is warranted. If the percentage of graduates unemployed is considered, the co-op programs display a percentage of 5.1, while the non-co-op programs show a percentage of 3.1. Using the same test, a test statistic of 1.74 results which is not significant at the .05 significance level. Consequently, although a significantly greater percentage of graduates of co-op programs are currently employed, there is no significant difference in the rates of unemployed graduates. This suggests that a greater proportion of the graduates of non-co-op programs are engaged in other activities which result in their being unavailable for employment. These activities include continuing their education, military service, family responsibilities, etc.

The third and fourth measures of effectiveness in Table 5 together provide another means of comparing the two methods. Of interest here might be the increase in wage rate based on the follow-up period of 13 to 18 months. Table 6 summarizes this information for the

TABLE 6. COMPARISON OF WAGE RATES BASED ON A FOLLOW-UP PERIOD OF 13 to 18 MONTHS

Program	Average Most Recent Wage Rate ($/hr.)	Average Entry Wage Rate ($/hr.)	Average Increase in Wage Rate ($/hr.)
CO-OP			
Distributive Education	$2.66	$1.95	$0.71
Diversified Cooperative Training	2.60	2.17	0.43
Cooperative Office Education	2.20	1.69	0.51
Trade and Industry	3.33	2.04	1.29
Cooperative Work Experience	-	-	-
All Co-op Programs	2.54	1.92	0.62
NON-CO-OP			
Auto Mechanics	$2.95	$2.22	$0.73
Auto Body	3.02	2.07	0.95
Electricity/Electronics	2.68	2.54	(decrease)
Drafting	2.89	2.24	0.65
Machine Trades	3.19	2.60	0.59
General Office	2.08	1.81	0.27
Steno	2.44	2.00	0.44
All Non-co-op Programs	2.73	2.28	0.45

present study. The average wage rate increase for graduates of co-op programs based on this follow-up period was $0.62 per hour. For graduates of non-co-op programs, the average wage rate increase was $0.45 per hour. However, the graduates of co-op programs had an average entry wage rate lower than those for non-co-op programs, so that even with the larger increase, these same graduates had a lower average most recent wage rate. The most recent wage rates differ by $0.19 per hour. The Aspin-Welch test of significance[4] conducted on these most recent wage rates yields a test statistic of 2.23 which indicates that the graduates of the non-co-op programs have significantly higher wage rates on the average based on a 13 to 18 month follow-up period. However, since missing data amounted to approximately 61 percent for Entry Wage Rate, and almost 80 percent for Most Recent Wage Rate, the generality of this conclusion is questionable. It is important to consider the occupational areas that are included in non-co-op programs versus co-op programs. For example, the labor market conditions are certainly different for auto mechanics versus sales clerks.

The fifth and sixth measures of effectiveness in Table 5 offer a comparison of vocational programs in terms of the degree to which the programs serve the employment needs of the communities. There seems to be little difference between co-op programs and non-co-op programs on these measures. However, it is interesting to note the change for all programs after the follow-up period. Initially, 95 percent of the employed students in all programs obtained employment within the local labor market, and at the time of the follow-up this percentage dropped to about 90 percent. A test of significance[5] on this difference yields

level when the Aspin-Welch Test of Significance[6] is applied to the data, yielding a test statistic of 2.49. In realistic terms, a one-month differential may not be very meaningful.

The final measure of effectiveness in Table 5, Average Weeks After Graduation Until Obtaining Full-Time Employment, shows a difference of 1.5 weeks between co-op and non-co-op programs. This is significant at the .05 significance level when the Aspin-Welch Test of Significance is applied, yielding a test statistic of 2.10. There is quite a bit of variation for individual program areas in this measure. However, the data appear to reflect the fact that co-op students tend to find full-time employment sooner than non-co-op students. This seems realistic in that the graduates of co-op programs in some cases continue employment with the same employer they had before graduation. Once again, however, this 1.5 week differential may not mean much in a practical sense.

In summary, the ten effectiveness measures estimated for the data collected under the present study indicate the following:

- There is no significant difference in percentage of students successfully graduated from co-op and non-co-op programs.
- There is no significant difference in the unemployment rates of graduates of both types of programs although a significantly higher percentage of the co-op graduates entered the labor market sooner.
- Graduates of co-op programs entered the labor market with a lower entry wage rate which increased more rapidly than the wage rates of graduates of non-co-op programs; however, after a 13 to 18 month follow-up period, the graduates of non-co-op programs still had a significantly higher wage rate. It is important to remember that the labor market conditions in non-co-op occupational areas are different than those for co-op areas, e.g., auto mechanics versus sales clerk.

- There is no significant difference in the percentage of graduates entering the local labor market as opposed to those entering other labor markets for the two types of programs; however, after a follow-up period, it appears that this percentage drops significantly for both types of programs.

- There is no significant difference between program types on the percentage of graduates admitted to formal apprenticeship programs.

- There is no significant difference between program types with respect to employment stability, measured as the precentage of graduates with two or less employers during the follow-up period; the stability measure appears favorable for both types of programs.

- The graduates of non-co-op programs have an average length of longest employment which is one month greater than co-op program graduates for the follow-up period, and this difference is statistically significant. Practically, however, this is not a great difference.

- Co-op graduates tend to find full-time employment an average of 1.5 weeks sooner than non-co-op graduates which is a statistically significant difference, but not a practical difference.

These results are indicated by the present study but caution should be exercised in assuming that they hold in general. Since the sample of programs selected was not made in a random manner, the generality of the conclusions to cover all geographical regions, program areas, etc., is questionable. Furthermore, it would be desirable to improve the data collection processes in order to reduce the amount of missing data encountered under the present study.

Survey of Employers

This was a minimal survey of employers in each community. Each school district provided us with about 15 firms that had hired the majority of graduates of vocational programs. We mailed 200 questionnaires and received completed questionnaires from 90 firms. This is a 45 percent response rate.

The size of the firms based on the number of employees ranged between 3 and 5,000, with a mean of 377. The distribution of firms based on three size categories is as follows:

Number of Employees	Number of Firms	Percentage
Less than 25	36	40.0%
25 to 100	21	23.3%
Greater than 100	33	36.7%
Total	90	100.0%

Thus, there is a fairly good representation of firms based on the number of employees.

Several points must be kept in mind in reviewing the results of this survey.

- The questionnaire is an attitudinal instrument that does not require any analysis of data on the part of the respondent.
- The school district personnel provided the names of the potential respondents. In every case we asked for an unbiased list.
- It was essential that the firm have knowledge and experience with both co-op and non-co-op vocational graduates. In many cases we suspect that this meant that the firms had worked with co-op students while they were in school. Thus, there is probably an inherent bias stemming from this. Of course, we have no way of knowing whether the bias is positive or negative with regard to co-op students.

- The sample size (90 responses) is small.
- The respondent may be expressing an attitude based on a small sample of employees who were graduates of either co-op or non-co-op vocational programs.

The questionnaire is divided into three main parts:

- Hiring and training experiences
- Experience during the adjustment period of employment (first 6 months)
- Job performance after the first 6 months of employment

Table 7 shows the questionnaire items for each of the three parts.

Figures 3 through 6 are summaries of the results of the survey.

TABLE 7. EMPLOYER SURVEY QUESTIONNAIRE ITEMS

HIRING AND TRAINING EXPERIENCES

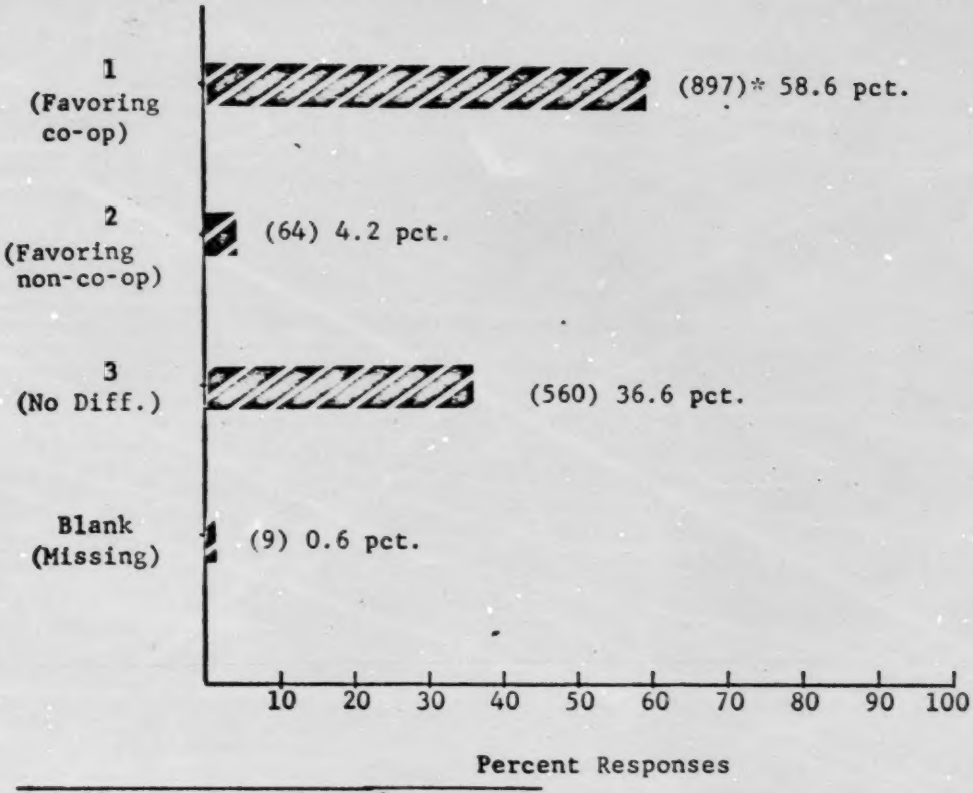
1. Generally, the proportion hired of those who apply is greater in the case of . . .
2. Generally, the entry level wage is higher in the case of . . .
3. Generally, the period of initial training is less in the case of . . .
4. Generally, the cost of initial training is less in the case of . . .

EXPERIENCE DURING THE ADJUSTMENT PERIOD OF EMPLOYMENT (First 6 Months)

5. Generally, the overall quantity of production or service is greater in the case of . . .
6. Generally, the overall quality of work is better in the case of . . .
7. Generally, the motivational characteristics are better in the case of . . .
8. Generally, the work habits are better in the case of . . .
9. Generally, the manipulative skills are better in the case of . . .
10. Generally, the human relations skills are better in the case of . . .
11. Generally, the conceptual skills are better in the case of . . .
12. Generally, the average absentee rate is less in the case of . . .
13. Generally, the average proportion of dismissals is less in the case of . . .

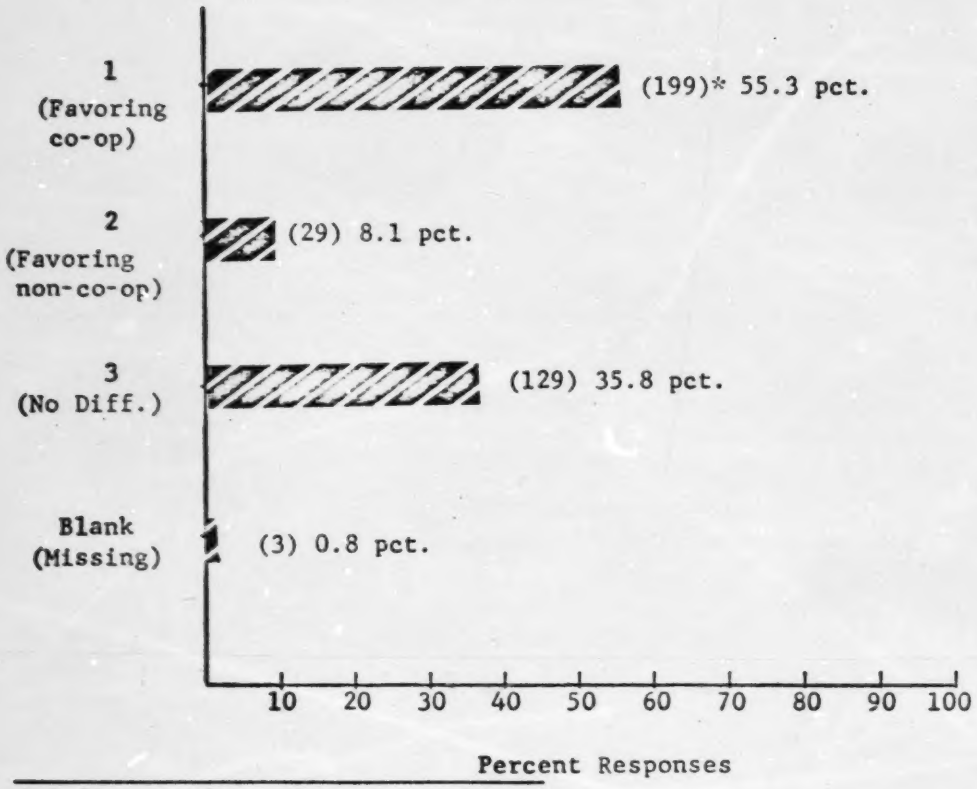
JOB PERFORMANCE AFTER THE FIRST 6 MONTHS OF EMPLOYMENT

14. Generally, the overall quantity of production or service increases more rapidly in the case of . . .
15. Generally, the overall quality of work increases more rapidly in the case of . . .
16. Generally, the average wage increases more rapidly in the case of . . .
17. Generally, the average proportion of dismissals is less in the case of . . .



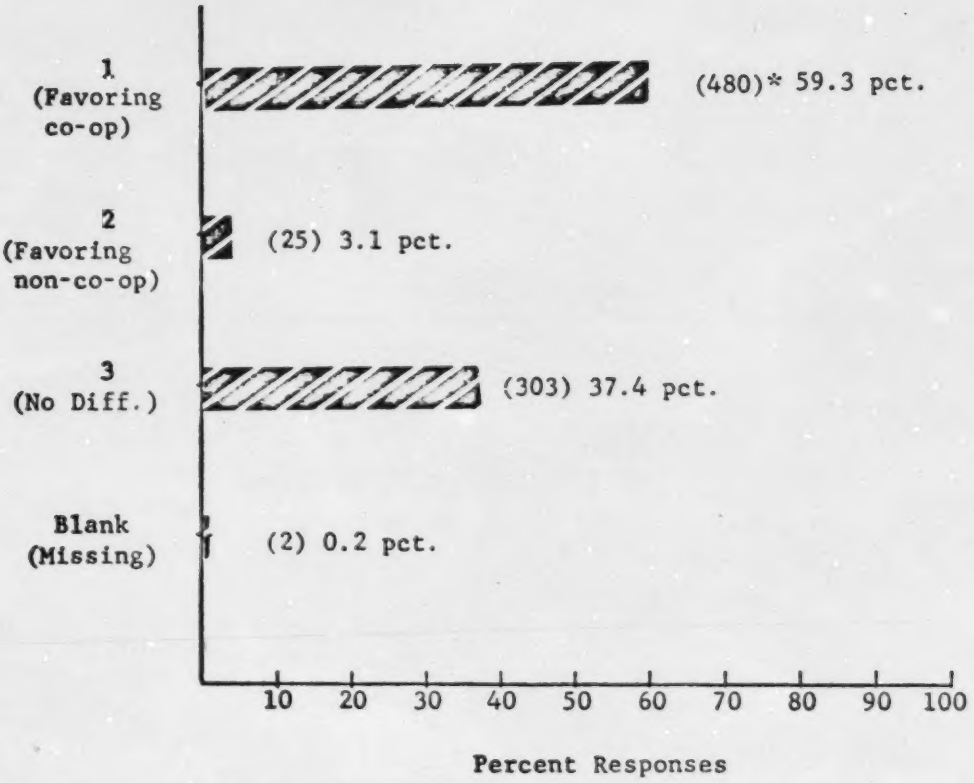
* Indicates the number of responses.

FIGURE 3. RESULTS OF EMPLOYER SURVEY, ALL QUESTIONNAIRE ITEMS



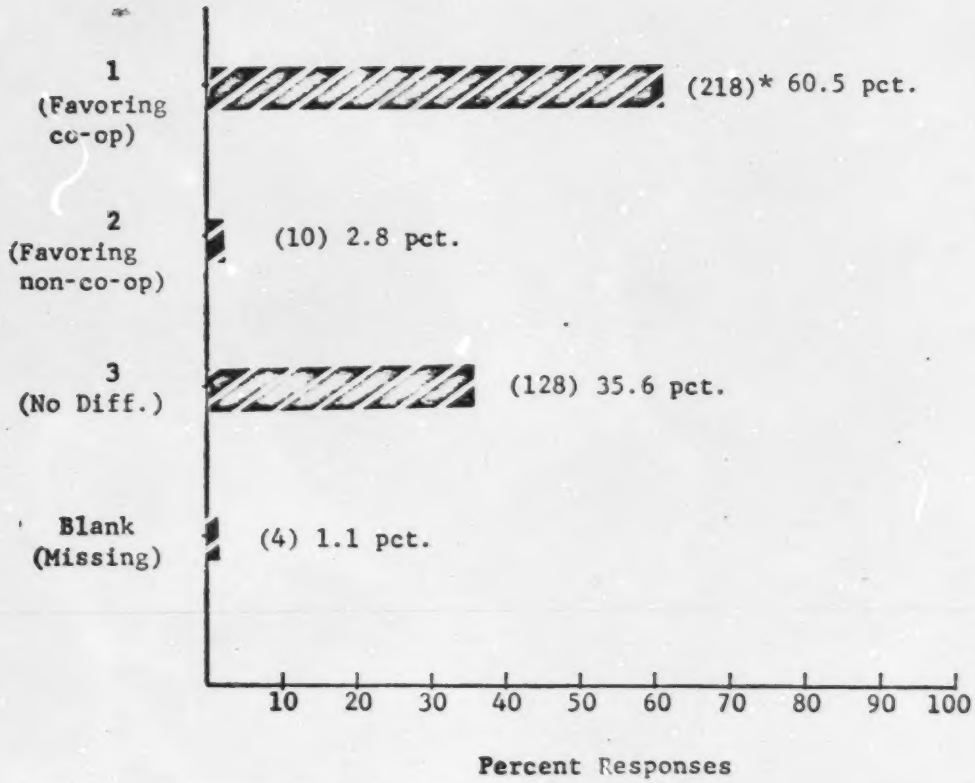
* Indicates the number of responses.

FIGURE 4. RESULTS OF EMPLOYER SURVEY, QUESTIONNAIRE ITEMS ON HIRING AND TRAINING EXPERIENCES, ITEMS 1 THROUGH 4



* Indicates the number of responses.

FIGURE 5. RESULTS OF EMPLOYER SURVEY, QUESTIONNAIRE ITEMS ON EXPERIENCE DURING THE ADJUSTMENT PERIOD, ITEMS 5 THROUGH 13



*Indicates the number of responses.

FIGURE 6. RESULTS OF EMPLOYER SURVEY, QUESTIONNAIRE ITEMS ON JOB PERFORMANCE AFTER THE FIRST 6 MONTHS OF EMPLOYMENT, ITEMS 14 THROUGH 17

Interpretation of Results of Employer Survey

These results show a very definite favorable attitude on the part of employers toward the graduates of co-op vocational programs. Figure 3 shows that the percentage of responses favoring co-op graduates is 58.6 percent versus 4.2 percent for non-co-op graduates, with 36.6 percent indicating no significant difference. The results are very similar for the three main parts of the survey -- Figures 4 through 6.

The results for each questionnaire item show that the co-op graduates are favored for all items.

Admittedly, there are several aspects of this survey that can be questioned. We cannot use these results in an absolute sense to conclude that co-op vocational programs are better than non-co-op programs; however, there is no question that the majority of the ninety employers that responded definitely have a favorable attitude toward the graduates of co-op programs.

We are very pleased with this instrument. Evidently it is clearly presented and people can complete it fairly easily. It would be very easy to use this instrument on a large, random sample of firms throughout the country in order to obtain a preliminary view of the attitudes of employers toward employees who are graduates of co-op vocational programs versus those who are graduates of non-co-op vocational programs.

FINDINGS AND CONCLUSIONS

This analysis was a preliminary attempt to investigate differences in cost and effectiveness of co-op vocational programs versus non-co-op programs. The main finding is that there does not appear to be a clear-cut difference between the cost of providing vocational programs based upon the co-op method and the cost of providing those based upon the non-co-op method. It is premature to conclude that this is generally the case since the data used here were not based on random sampling nor were they representative of all programs conducted in the United States today. There may very well be other cases in other school districts that would show a clear-cut difference.

The more significant finding in the cost analysis is the strong relationship exhibited between the student-teacher ratio and either the Cost Per Student or the Cost Per Student-Hour measures. Even though the sample was not large and some elements of cost were estimated (equipment replacement cost), the student-teacher ratio serves very well to explain the variation in the two cost measures.

It is a fact that the greatest cost element in the educational system is the direct instructional expense. It is only logical that the cost is a function of the student-teacher ratio. That is, the most effective way to control costs is to control the student-teacher ratio. Obviously from an efficiency point of view, it is less costly to have a ratio of 30 to 1 than a ratio of 15 to 1. It must be remembered of course that the effectiveness of the educational process may

change significantly with this ratio, and this should be considered in any total analysis.

The effectiveness comparisons are based mostly on standard follow-up information provided by the schools on graduates of the vocational programs. In addition, a brief survey of employers was conducted to obtain some attitudes from employers regarding graduates of co-op versus non-co-op programs.

On the basis of school-provided information, we note differences between co-op and non-co-op program graduates as follows:

- Graduates of co-op programs enter the labor market with a lower entry wage rate that increases more rapidly, but graduates of non-co-op programs still earn a higher rate after a follow-up period of 13 to 18 months. It must be remembered that this is probably due more to the occupational area itself and the labor market conditions than to the educational experiences.

- The graduates of non-co-op programs remain with their longest full-time employer slightly longer (one month) than do the graduates of co-op programs; based upon a 13 to 18 month follow-up period. This difference is significant in a statistical sense, but not in a practical sense.

- Graduates of co-op programs tend to find full-time employment slightly faster than their non-co-op counterparts, but the difference is only 1.5 weeks--not a very practical difference.

There was no significant difference between the graduates of co-op programs versus non-co-op programs on the basis of the following measures:

- Those students who successfully graduate

- Unemployment rates

- Those entering the local labor market versus those leaving the local community
- Those graduates who entered formal apprenticeship programs
- Employment stability as measured by the number of different employers after graduation.

Our overall conclusion based on the follow-up measures provided by the schools is that there is no obvious difference (in a practical sense) between graduates of co-op vocational programs and graduates of non-co-op programs. The effect of the occupation itself and the labor market conditions are probably more important than the vocational schooling, or the method used in providing vocational training.

The employer survey very definitely showed a difference. The sample of employers favored graduates of co-op programs (58.6 percent) over those of non-co-op programs (4.2 percent), with 36.6 percent indicating no difference, and 0.6 percent missing data. We must recognize that this sample was small (90 out of 200 employers returned the questionnaire) and that there were some inherent biases that we were unable to control, due to the choice of employers who received the questionnaire. The school districts provided the lists of employers and individuals to whom we sent the questionnaire. We do not think that there was any deliberate attempt to bias the results, but we could not design the survey to uncover any bias, due to the limited scope of this part of the study. Nevertheless, it is important to note that a majority of the sampled employers definitely favor graduates of co-op programs.

Our overall conclusions based on the employer survey are that employers tend to favor graduates of co-op programs and that the process of measuring effectiveness through a questioning of employers results in a much more clear-cut differential between the two methods than does the follow-up information normally collected by school systems.

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